TESTICULAR TRANSPLANTATION

SUCCESSFUL AUTOPLASTIC GRAFT FOLLOWING ACCIDENTAL CASTRATION

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PRESENTED BEFORE THE WISCONSIN UROLOGIC SOCIETY, BELOIT, WIS., APRIL 30, 1938, AND AT THE NEW YORK ACADEMY OF MEDICINE, JANUARY 17, 1940

LOSS OF THE TESTICLES in the adult as the outcome of criminal or punitive castration, traumatic accident and self-inflicted removal results in serious metabolic disturbances involving not only sexual functions but especially the nervous and muscular systems. Early recovery of the testicles with reimplantation into the scrotal region, observing certain physiologic considerations, offers the possibility of successful grafts. This procedure naturally is not applicable when surgical castration is performed for the removal of diseased testicles.

When the implanted tissue originates in the host it is called autogenous. The operation is termed autoplastic transplantation or reimplantation. The transplanted tissue becomes a graft after evidence is present that it "takes" or survives.

In transplants, the survival of viable testicular cells is dependent upon nutrition resulting from the penetration of a compatible host's circulation into the transplanted tissue which consequently must be inserted in such form as to expose a large proportion of incoming cells to vascularization by the host. Reimplantation of the whole testis, or large portions of it, into any part of the body has invariably resulted in little benefit and later sloughing. Tissue in the form of thin slices or mush injections are most apt to result in successful grafts.

Carl Moore's experiments have produced convincing proof that the testis attains its full development and functional capacity in the scrotum where the temperature is from three to six degrees below that of the internal parts of the body. A local tissue peculiarity in the scrotum may also be a factor in normal testicular development. The choice of the scrotum as the site for implantation is the *most important prerequisite* for success. The dartos layer is an ideal location for the introduction of transplants because of the total absence of fat, the presence of loose areolar tissue, the proper temperature and good vascularity.

The record of a patient observed over a period of two and one-half years is appended:

Case Report.—On October 12, 1937, a hospital call from Dr. H. G. Oakland brought the author to the pathetic sight of a young man, age 23, whose right arm had been amputated just below the elbow; and both testicles, scrotum and the skin of the penis had been torn from his body. The accident had occurred less than one hour previously. While working in a box factory he had leaned forward over a lathe carrying a revolving knife

FIG. 1.—External genitals as they appeared after recovery from underwear.

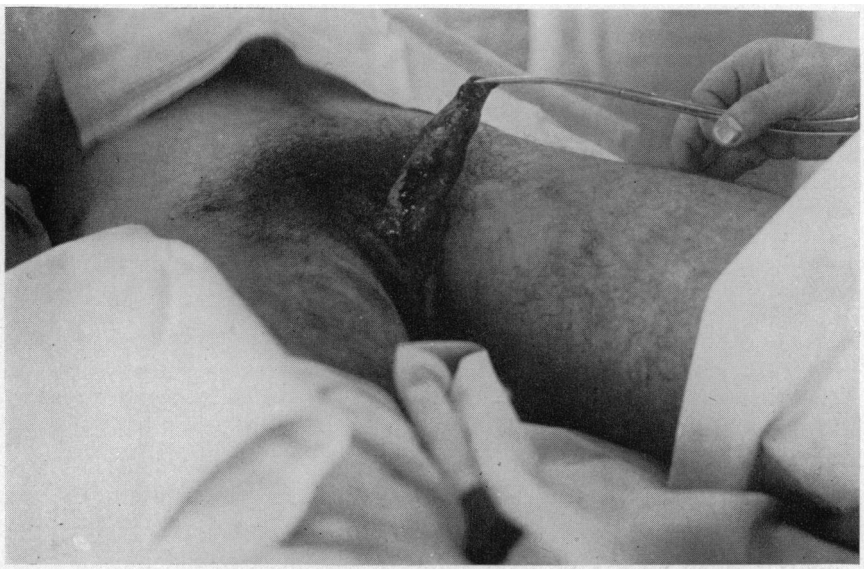

FIG. 2.—Appearance of the genitals before preparation for operation. The penis is denuded except for the semimucosal or inner part of the prepuce.

when his trousers were caught up and quickly wound into the machine. His right hand grasped his trousers, was drawn into the whirling knife and amputated together with the external genitals. On arrival at the hospital he was in shock—severely exsanguinated. Doctor Oakland had controlled the bleeding in the arm stump. There was no bleeding from the genital wounds. With the aid of three blood transfusions during the night there was rapid recuperation.

The scrotal skin, intact testicles and the skin of the penis, still attached to one another, were found in the patient's underwear and placed in a refrigerator overnight in a normal saline dressing (Fig. 1).

FIG. 3.—Photograph showing complete healing, with little distortion and full erectile function.

The following morning, under general anesthesia, working concurrently with Doctor Oakland who repaired the arm stump, reconstruction of the genitals was carried out. Fourteen sliced cross-sections of testes, each about 2 Mm. in thickness, were implanted in the scrotal wound and covered with the flaps of the remaining scrotal skin. One section of epididymis was also implanted.

The accident left the semimucosal or inner part of the prepuce still covering the glans (Fig. 2). This part of the prepuce was simply inverted over the glans and covered about 3 cm. of the distal part of the shaft, where it was held in place with a few interrupted catgut sutures. The remainder of the denuded penis was covered with a full-thickness graft made up of a collar of the very skin which had been torn from this area. All of the skin grafting was successful except the full-thickness one on the proximal part of the shaft which survived in only isolated areas and had to be largely replaced at several later sittings with pinch-grafts taken from the thigh. The patient left the hospital, December 14, 1937, apparently well, with a normally functioning penis (Fig. 3).

Naturally, the pertinent questions concerning this patient are: (1) Have the testicular transplants been successful; and (2) how long will the grafts function? For an answer to these questions one must consider the prostate gland which is the most sensitive clinical indicator of testicular function. Experimentally, in castrated male animals, the administration of androgenic agents is promptly followed by an increase in size of the atrophied prostate

and seminal vesicles. This reaction, in fact, is the basis of an assay method. Carl Moore, Deansly, McCullagh and others have called attention to the prompt atrophy of the prostate following castration.

Subsequent Course.—True to form, our patient at the end of two and one-half weeks had developed a very definite shrinkage in the size of the gland. Instead of the usual succulent gland, typical of young men at his age, it had shrunken at this early post-operative stage to about one-half normal size. At the end of six weeks it was barely palpable and at three months could be outlined with difficulty by rectal palpation. Continued periodical rectal examinations revealed a gradual regeneration of prostatic tissue during ensuing months, indicating that the grafted testicular cells were surviving and probably elaborating secretion (Chart 1).

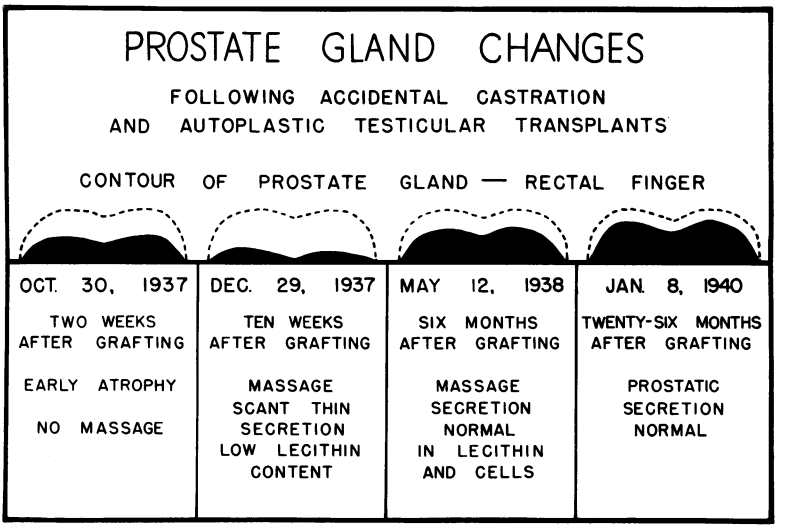

CHART 1.

He has remained normal since that time, regained his full vigor and endurance, has normal libido and frequent erections, and has experienced ejaculations about once monthly. A number of definite nodules in the scrotal region at the site of the grafts, some the size of a pea, have persisted.

There has been no deviation from normal in numerous repetitions of the following tests: Friedman test for gonadotropin, basal metabolism test, blood cholesterol and sugar tolerance. Tests for the presence of androgenic hormones in the urine demonstrated increasing excretion of androgens. The last assay, completed August 19, 1939, showed an output of approximately 57 international capon units per day as compared to an output of 20 to 30 capon units per day during the first weeks following the operation (Chart 2). Because of the normal clinical course there has been no administration of either the extracts of thyroid, anterior pituitary-like substance or of testicular hormone at any time during his convalescence.

COMMENT.—The result in this patient has been very gratifying up to the present and we are hopeful that prolonged function will be realized. The grafted tissue in this patient possesses two essential qualifications for success: First, it is autogenous, being returned to its original host; and, second, it has been placed in its normal scrotal habitat. The early atrophy and then

regrowth of the prostate gland indicates that there was, primarily, a lack of cellular function but, later, adaptation and regeneration took place. The increasing urinary excretion of androgens now adds to the encouraging outlook.

The precautions required in tissue culture and transplantation were observed, namely: The reimplantation was carried out as promptly as possible after removal; sudden and repeated changes in temperature were avoided as well as direct exposure to sunlight; and there was no undue trauma or drying.

The successful result in this patient prompted an attempt to graft testicular tissue into human castrates. Homoplastic transplantation was recently performed on two castrates, who received injections under the scrotal skin

RECORD OF TESTS ON GRAFTED CASTRATE J.A.

DATE	BLOOD HEMOGLOB	FRIEDMAN GONADOTROPHIN TEST	BASAL METABOLISM	URINARY ANDROGENIC ASSAYS	BLOOD CHOLESTEROL	GLUCOSE TOLERANCE TEST	
NOV. 6 1937	58%	NEGATIVE	+9.3%	22 CAPON UNITS DAILY FIVE DAY COLLECTION	119.8 MGS.	BLOOD SUGAR BEFORE 106.8 ½ HOUR AFTER 184.3 1 HOUR AFTER 174 2 HOURS AFTER 150.4 3 HOURS AFTER 87.3	ONE HOUR URINE POS. WITH 5 GTTS. TWO HOUR URINE POS. WITH 10 GTTS. OTHERS NEGATIVE
DEC. 15 1937	78%	NEGATIVE	+6.1%	27 CAPON UNITS DAILY FIVE DAY COLLECTION	159.2 MGS.	BLOOD SUGAR BEFORE 99 ½ HOUR AFTER 186.9 1 HOUR AFTER 167.4 2 HOURS AFTER 98.5 3 HOURS AFTER 93	ALL URINE SUGAR NEGATIVE
APR. 27 1938	80%	NEGATIVE	-17.9%	44 CAPON UNITS DAILY FIVE DAY COLLECTION	127.9 MGS.	BLOOD SUGAR BEFORE 101 ½ HOUR AFTER 120.5 1 HOUR AFTER 113.6 2 HOURS AFTER 87.3 3 HOURS AFTER 79.2	ALL URINE SUGAR NEGATIVE
JAN. 8 1940	94%	NEGATIVE	-4%	57 CAPON UNITS DAILY FIVE DAY COLLECTION	183.1 MGS.	BLOOD SUGAR BEFORE 102.6 ½ HOUR AFTER 128.8 1 HOUR AFTER 149.3 2 HOURS AFTER 105.8	ALL URINE SUGAR NEGATIVE

CHART 2.

of a testicular mush made up of the testicles of a young man killed in an accident. Preliminary blood grouping of donor and recipients was carried out. Their compatibility was established. This most important step is usually overlooked. A report on the results of these operations and others to follow will be published after several years of observation.

SUMMARY

(1) Autoplastic testicular transplants were carried out in a patient, age 23, following accidental castration.

(2) Successful graft resulted. Observation during two and one-half years demonstrated regeneration of the prostate gland, normal sexual behavior, and the persistence of normal clinical and laboratory tests.

(3) The method of transplantation herein described is recommended for the replacement of testicular tissue which is lost in the maneuvers of warfare.